

FINAL

Charge to Cyanobacteria Science Work Group

Background

In 2009 the California legislature passed the Delta Reform Act creating the Delta Stewardship Council. The mission of the Council is to implement the coequal goals of the Reform Act and provide a more reliable water supply for California while protecting, restoring, and enhancing the Delta ecosystem. The Council wrote and adopted a Delta Plan in 2013 to implement these goals. Chapter 6 of the Delta Plan deals with water quality and contains recommendations to implement the coequal goals of the Delta Reform Act. Recommendation # 8 states, in part,

“...the State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards should prepare and begin implementation of a study plan for the development of objectives for nutrients in the Delta ... by January 1, 2014. Studies needed for development of Delta... nutrient objectives should be completed by January 1, 2016. The Water Boards should adopt and begin implementation of nutrient objectives, either narrative or numeric, where appropriate, in the Delta... by January 1, 2018.

Potential nutrient related problems identified in the Delta Plan for evaluation are:

1. Decreases in algal abundance and shifts in algal species composition,
2. Increases in the abundance and distribution of macrophytes, including water hyacinth and Brazilian waterweed,
3. Increases in the magnitude and frequency of cyanobacteria blooms

This charge addresses issue #3, assessing whether the observed increase in the magnitude and frequency of cyanobacteria blooms in the Delta is the result of long term changes in nutrient concentrations and whether management of nutrient loads can remedy the problems associated with cyanobacteria.

In the spring of 2014 Water Board staff wrote a new five-year Delta Strategic Work Plan to help prioritize Delta activities. The five-year plan was presented as an information item at the February 2014 Board meeting. Item five in the Strategic Plan lays out tasks, schedule and deliverables to begin implementing the nutrient recommendations in the Delta Plan (Figure 1). The Strategic Plan included the formation of a Technical Advisory Committee and a Stakeholder Advisory Group (which was later combined into the Stakeholder and Technical Advisory Group or STAG) to help respond to Delta Plan recommendations and to identify additional issues of concern. The Water Board also formed several Science Work Groups to help develop white

papers on the three potential nutrient related problems. White papers may include recommendations for research to resolve outstanding questions about the efficacy of nutrient management to control cyanobacteria. These recommendations will be incorporated into the Nutrient Research Plan. Draft white papers and a draft Nutrient Research Plan will be available for review by the STAG and the State Board's Independent Science Review Panel in 2015. A final Nutrient Research Plan addressing all review comments is anticipated to be completed and presented as an information item to the Central Valley Regional Water Board and, if requested, the Delta Stewardship Council in 2015.

The State Water Resources Control Board contracted through the Southern California Coastal Water Research Project with Dr. Mine Berg, Applied Marine Sciences, to write the cyanobacteria white paper. A draft outline of the white paper is included as Appendix A. Dr. Berg is scheduled to complete a first draft of the white paper in December 2014 and will be available to discuss it in early 2015.

Charge to Science Work Group

The charge to the Science Work Group is to review and comment on the draft white paper. The Work Group is intended to be a group of experts who will vet the conclusions of the white paper and bring to the attention of Regional Board staff and to Dr. Berg any peer reviewed or grey literature that either contradicts or extends the conclusions in the white paper. The Science Work Group is also charged with preparing a prioritized list of recommendations for future research addressing whether ambient nutrient concentrations contribute to the present cyanobacteria impairment and whether nutrient reductions will reduce the severity of the blooms and of toxin production. The prioritized list of recommendations for future research will be included in the Nutrient Research Plan. The White Paper and Research Plan are intended to provide the rationale and roadmap for future research to resolve outstanding issues about the need for nutrient management to control the magnitude and frequency of cyanobacteria blooms and toxin formation.

Evaluation Process

Three sessions are envisioned for the Cyanobacteria Work Group. It is hoped that all members will be able to participate in person at all meetings. However, if not, a Web Ex will be arranged.

First Meeting The primary purpose of the first meeting is for the Cyanobacteria Science Work Group to review and provide comments on the white paper. At least two weeks prior to the first meeting, Dr. Berg will circulate a draft of her paper and make available in PDF format all key references in the report. At the meeting Dr. Berg will summarize her findings in an oral report. The presentation will include a conceptual model of factors controlling cyanobacteria in the Delta and a list of information gaps and recommendations for future research.

The Work Group will evaluate these findings and determine whether:

- (1) The principal physical and biological factors promoting cyanobacteria blooms and toxin production in the Delta have been identified.
- (2) All peer reviewed and grey literature studies that evaluate the efficacy of nutrient management for decreasing the magnitude and frequency of cyanobacteria blooms and toxin formation have been reviewed and summarized.
- (3) The relative importance of nutrients versus other factors in promoting cyanobacteria abundance and toxin production have been correctly evaluated.
- (4) The white paper findings are fully supported by the literature discussed in the paper and whether there is additional information that either supports or refutes the findings.
- (5) The prioritized list of recommendations to resolve outstanding nutrient management questions is appropriate and consistent with available information from the Delta and elsewhere.

At the last STAG meeting Stakeholders reviewed the charge and suggested changes in the charge and additional questions for the Science Work Group. The Science Work Group should, to the maximum extent possible, address these concerns while still answering the basic charge to the group. One stakeholder commented:

“The charge to identify “future research addressing whether ambient nutrient concentrations contribute to the present cyanobacteria problem and whether nutrient management will reduce the severity of the problem needs to be sharpened. The question is not whether nutrient concentrations “contribute” and whether management can “reduce the severity”; instead, the management-relevant questions are:

- 1) Is nutrient management necessary for successful management of cyanobacteria (i.e. can cyanobacteria management be successful without nutrient management)? If “yes” what level of nutrient management is the minimum needed for success?*
- 2) If the answer to 1 is “yes”, then is nutrient management alone sufficient to control cyanobacteria?*
- 3) What combinations of management actions (including different levels of nutrient management and non-nutrient management strategies) are likely to achieve equal levels of benefit with regard to cyanobacteria management? What are the likelihoods, costs, and potential unintended consequences of these different strategies?*

#3 is particular important for developing risk/reward and cost/benefit analysis of different approaches.

All of the above, I suspect, will require development in advance of goals and objectives (specific, measureable, achievable, relevant, and time-bound targets; S.M.A.R.T.) for management so that we can evaluate which strategies are likely to succeed”.

Another Stakeholder noted that in 2009 CALFED convened an Independent External Review Panel to prepare a framework for research to address the role of Ammonia/um in the Bay Delta Estuary¹. Research topics #5 and #6 dealt with cyanobacteria. Topic #5 suggested that research be conducted to determine how cyanobacteria blooms and toxin levels affect higher trophic level organisms, including POD species Topic #6 recommended research to determine the effect of climate change (increased temperature, intensification of spring freshwater discharge and decreased summer/fall flow) on the magnitude and frequency of cyanobacteria blooms. The Stakeholder asked what is now known about these issues and should their evaluation remain a high priority research topic.

A modelling work group is also being formed to provide advice on development of coupled hydrodynamic and water quality models to better inform future water quality in the Delta. The Cyanobacteria Work Group is asked to review the charge to the Modeling Group and provide modelling related questions to help inform the understanding of how nutrients and other physical and biological factors influence cyanobacteria blooms. These questions will be forwarded to the Modelling Group and are intended to help them recommend the best suite of models for use in the Delta.

Second Meeting The purpose of the second meeting is to continue the discussion of the white paper with an emphasis on the review and prioritization of a list of recommendations for follow up studies. Comments from the Cyanobacterial Work Group may be provided orally or in writing to Dr. Berg and to Regional Board staff. These comments along with those of the STAG and the State Board Independent Science Review Panel will be addressed in the final white paper.

Third Meeting A third and final session may be scheduled, at the discretion of the Work Group, to review suggested changes to both the white paper and to the prioritized list of questions for future research after comments from the Science Work Group, STAG and State Board Independent Science Review Panel have been received and reviewed.

Products of the work group process will include:

- Science Work Group white paper and prioritized research recommendations.
- STAG comments and recommendations.
- State Board Independent Science Panel comments and recommendations
- Final white paper and research plan after comments from the State Board Independent Science Panel and STAG have been received and addressed.

This package is intended to support the transparency of the process and ensure that Regional Water Board staff and other interested parties have a complete suite of information needed for their considerations and decision making.

¹ http://www.science.calwater.ca.gov/events/workshops/workshop_ammonia.html

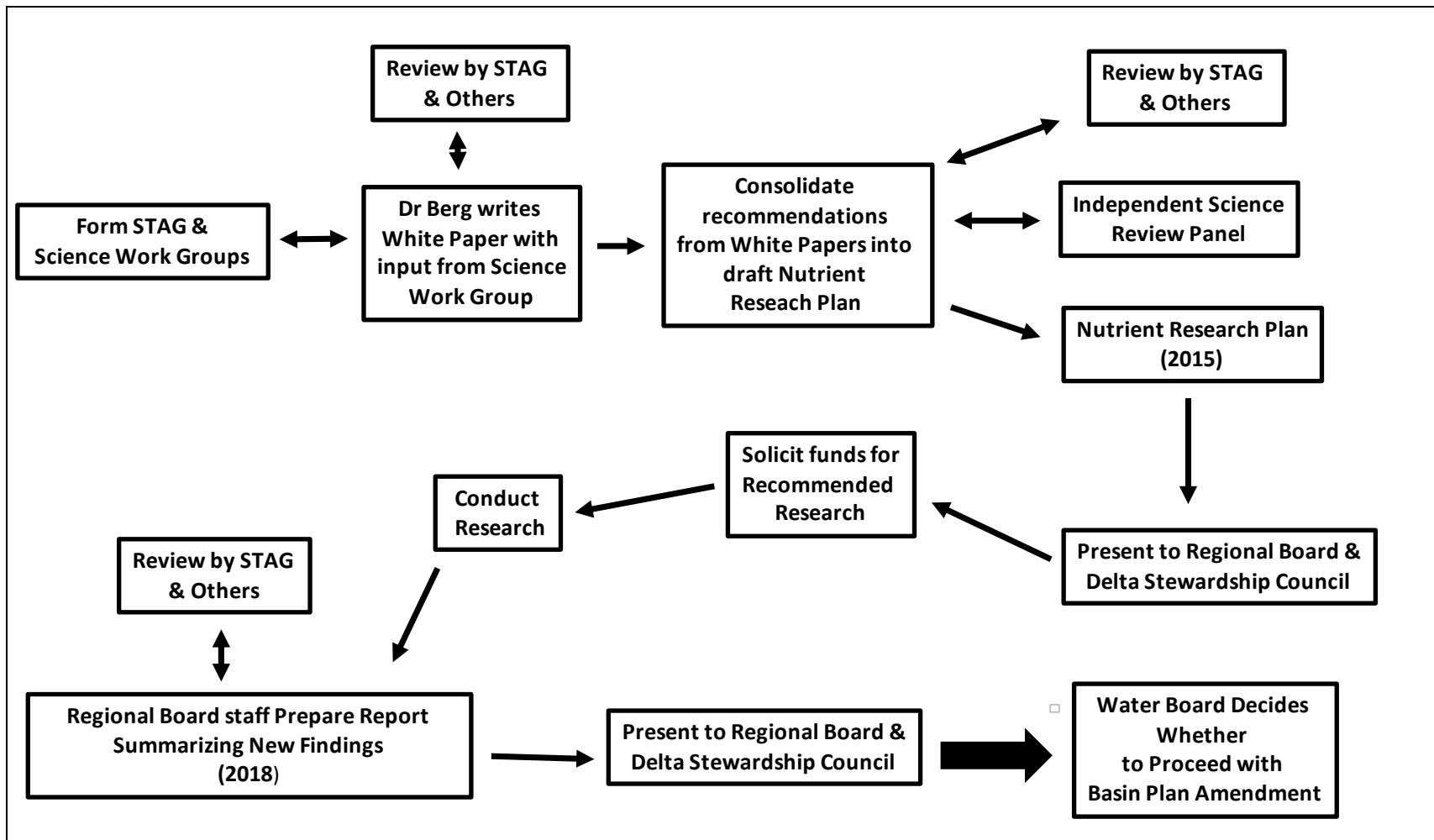


Figure 1. Tasks and schedule for developing and implementing the Nutrient Research Plan outlined in the 2014 Delta Strategic Work Plan. Staff will solicit input at a 2018 Regional Board meeting as to whether nutrient objectives are needed for the Delta and whether staff should begin their development.

Table 1 List of individuals for the Cyanobacteria Science Work Group

Individual	Agency/Institution	Cyanobacteria Work Group
David Senn	San Francisco Estuary Institute	X
Lisa Thompson	Sacramento Regional Combined Sanitation District	X
Tim Mussen	Sacramento Regional Combined Sanitation District	X
Alex Parker	California Maritime Academy	X
Stephanie Fong	State and Federal Contractors Water Authority	X
Peggy Lehman	Department of Water Resources	?
Raphael Kudela	U.C. Santa Cruz	X
Mine Berg	Applied Marine Sciences	X
Martha Sutula (Facilitator)	Southern California Coastal Water Research Project	X
Karen Taberski	San Francisco Regional Water Quality Control Board	X
Kim Ward	State Water Resources Control Board	X
Daniel Orr	California Department of Fish and Wildlife	X

Key: X= Individual has agreed to participate in the Work Group. ?=individual has been identified as a potential candidate but has not yet been contacted.

Appendix A

Draft Cyanobacteria Review Outline

Questions to address in the review:

1. What is the relative importance of nutrients versus other factors in promoting cyanobacteria dominance and/or cyanotoxin production in aquatic ecosystems globally?
2. What are the spatial and temporal trends in cyanobacteria dominance and/or cyanotoxin production in the Delta?
3. What is the relative importance of nutrients versus other factors in promoting cyanobacteria dominance and/or cyanotoxin production in the San Francisco Bay-Delta?
4. What are the key data gaps and recommended future studies?

Review Outline

1. Executive Summary
2. Introduction, Purpose of Review, and Key Questions
3. Ecology of Cyanobacteria
 - A. Basic photophysiology (pigments, light capture, photosynthesis)
 - B. Nitrogen fixation
 - C. Toxin production
 - D. Cyanobacterial ecotypes
 - i. Filamentous
 - ii. Unicellular
 - iii. Freshwater
 - iv. Marine/Estuarine
 - v. HABs
4. Ecological Characteristics that promote cyanobacteria in Freshwater/estuarine Environments (emphasis on mechanistic description of how factors promote blooms/toxic production)
 - A. Temperature
 - B. Nutrients
 - C. Water column stability/mixing
 - D. Water clarity
 - E. Irradiance
 - F. Others...
5. Factors contributing to development of cyanobacteria blooms in the San Francisco Estuary-Delta region
 - A. Summary what species are found, their physiological tolerances along a fresh-marine continuum
 - B. Summary of spatial and temporal patterns in cyanobacteria blooms and cyanotoxins concentrations
 - C. Relative importance of nutrients versus other factors in controlling cyanobacteria dominance
 - D. Summary of key data gaps and recommended studies